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REFLECTIONS ON GOVERNMENT SERVICE

I. Doctrine and Practice in Large Scale Endeavors

by

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First of Three Lectures Presented in the
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I. Doctrine and Practice in Large Scale Endeavors

During several periods of Government service covering quite a number of years, it has been my privilege to share in a number of endeavors of large scale and considerable complexity. All had important primary objectives. All had potential for secondary and tertiary effects which could prove harmful or beneficial. Success in meeting the main objectives, and whether the other effects were maximized or minimized, depended in many cases on administrative decisions.

As I have reflected on these experiences, and sought the elements which might prove useful in future programs, I have come to believe that the greatest successes are achieved through deliberate, planned utilization of well known organizational concepts and administrative practices which are based on a well exercised but limited body of doctrine. This limited body of doctrine rests in turn on a quite limited set of theoretical formulations. Further, so much is clearly done without a basis in accepted doctrine that it is difficult indeed to find an administrator experienced in large scale endeavors who can relate the major part of his successful way of working directly to doctrine or theory. He knows that certain things move matters ahead, but is not sure another administrator could or would do the same with the same effect.

Today's need is, I believe, increased emphasis on research that will provide greater knowledge and deeper understanding as to what successful administrative leaders in large endeavors do and with what effect.

The successes we have had in weapons system and space developments in recent years suggest to some the use of the systems management approach to achieve similar success in many other fields, both public and private. And yet there is little to guide those who must decide between alternate approaches. We do know that complex, fully engineered systems work efficiently only when all components contribute properly to the effort.

As to history, in some cases quite large and very successful projects have started with clear-cut goals and required only short periods of gestation. Others, also successful, have been subjected to protracted periods of debate and much vacillation and indecision. Some successes and some failures have been enclosed within larger formal organizations such as a military service or a large diversified corporation. In this situation they could draw upon the parent for resources and could move with great power almost without regard for the niceties of administration. Some projects have received only informal assistance from existing structures and had to begin with virtually no base of power or organizational nucleus.

We all know that for success, every large endeavor with its widespread implications must have good leadership and good management. This sometimes comes from a close correlation between the chosen way

of working and accepted administrative doctrine; sometimes from the application of the prior experience of a group of competent leaders; and sometimes from the genius of one man. Careful study shows that very large endeavors seem peculiarly dependent for success on subtleties and flexibilities brought into play by the leadership group or by pressures on that group.

Society needs as much assurance of success as it can have when it commits its resources in large amounts. It needs assurance that the leaders to whom those large resources are entrusted will use them so as to strengthen, and not weaken, existing valuable institutions and groups in the nation's economic, social, and political structure.

Many of today's large endeavors, and those proposed, have management requirements that go beyond the state-of-the-art or proven capabilities of present forms and methods.

Scholarship and research in the disciplines on which future management groups must draw have been too slow to supply the need in such large endeavors. And it is an unhappy fact that research trends do not show that in the future we will be substantially better off.

Harvey Sherman, of the New York Port Authority, recently published a little book entitled <u>It All Depends: A Pragmatic Approach to Organization</u>. In it he points out that: "Programs, key people, or other conditions have changed, but the organization has not kept up . . . . The rapidity of change since World War II, as compared with all of history before that time, is so much greater than the rapidity of organizing to meet this change, that the problem we now face in

organization may well have changed in nature from one of adjusting organizations to meet present conditions; that is, maintaining equilibrium, to one of adjusting organizations to meet future unknown conditions; that is, maintaining desired disequilibrium."

Some students of administration believe we should change Sherman's words "desired disequilibrium" to "the lowest level of disequilibrium that will permit maneuverability under assured control."

The subtleties and flexible approaches which have been used to achieve success in many large endeavors can be thought of as a way of maintaining "desired disequilibrium." The skill with which factors of "disequilibrium" are related to the necessary level of stability or "equilibrium" is all important.

In my view, success in the further use of large scale endeavors could be in greater danger from too high a built-in equilibrium than from a needed state of disequilibrium.

NASA is undoubtedly an example of a large scale organized effort. For the ten years of its life, we have been constantly seeking to prepare for and organize to meet substantive and administrative conditions which could not be foreseen. We have sought to avoid those concepts and practices which would result in so much organizational stability that maneuverability would be lost. Our constant effort is to obtain a sufficient real time feedback from the fastest moving parts of our activity to enable us to alter our course as needed. We seek patterns of organization and administration that facilitate fast reaction times to signals of an emergency or of a short duration,

unforeseen opportunity. More than most enterprises, we must have speed in decisions and in their implementation. This makes Sherman's concept of "disequilibrium" particularly appropriate to NASA.

Beginning seven years ago, with a total work force of about 75,000 in our laboratories, in the plants of our contractors, and on the campuses of our university associates, we built up in five years to a work force of 420,000. During the past two years we have reduced this number by 140,000, or one-third. We do not know today whether we will have to make further sharp reductions, stabilize at present levels, or start to build up again. And yet, we can point to almost complete success in planning and carrying out a quite complete system for unmanned exploration of the moon. The first of a series of three lunar probes was the Ranger, which gave us the capability for handling a large volume of telemetered data which we could translate into photographs, some of which provided detail one thousand times greater than the best theretofore available. The second-generation lunar probe was the Surveyor, which gave us knowledge of the physical characteristics and composition of the lunar surface and confirmation that our design for a vehicle to land on the moon was workable. Surveyor's best pictures were one thousand times more detailed than those of the Ranger. So these two spacecraft improved previous resolution by a factor of one million. The third generation was the Lunar Orbiter, which photographed the entire front and back of the moon and took such detailed pictures that we could identify the landing site of the Surveyor and correlate the information from Surveyor's detailed but

local examination with conditions elsewhere on the moon. We have already selected a number of sites to which we are prepared to send astronauts for further exploration.

Two Mariner spacecraft have traveled to Venus and one to Mars, with large increases in our knowledge and understanding of these sister planets, their relations to the sun, and features common to them and to the earth. Several generations of earth orbital laboratories and deep space probes have explored the sun, the earth, the earth's weather, and provided communications relays. All have added to man's knowledge of the universe in which he lives and his capability to use this new knowledge. In the field of manned flight, Mercury led on to Gemini, with its record of sending 20 men out into space in 20 months and learning what it means to stay in space for 14 days, how to rendezvous and dock two spacecraft traveling 18,000 miles per hour, how to "walk in space," and how to splash down near a recovery ship.

I believe this NASA record, covering a brief 10 years, shows that, given competence in over-all management, this matter of maneuverability and flexibility--that is, the capacity to adjust to and to move forward in an unpredictable and sometimes turbulent environment--is perhaps the most important additional element required for success in the large scale endeavor. These would not be "large scale" unless the need they serve is urgent and important. Assurance of continued support through periods of difficulty is essential. In government enterprises what they do, how they do it, and who does it is almost always highly visible or open to inspection. Reporting of their activities

is frequently keyed to the controversial or spectacular. Continued support depends on results. Failures or sensational forecasts of failures reduce internal self-confidence and undermine the essential element of external support.

From a management standpoint the situation is not unlike that faced by the Wright brothers when they decided to couple a human pilot with his senses and muscles to a coordinated system of machine controls. This enabled the pilot to relate what he could see and what he could feel to what he needed to do as he maneuvered his vehicle to meet the air currents and turbulence which he encountered.

The Wright brothers used, for the first time, a system of three-dimensional controls within which all elements worked together in a way natural to the pilot. Extreme problems were encountered by other designers in their attempts to use uncoordinated controls. It was thus their coordinated system of controls more than advances in the engine or structure that produced successful flight. They developed a new kind of linkage of man and machine. They built into their "system" a certain amount of instability and made it work for them.

The problems of using rocket power to reach up through the air and make use of the unlimited environment of space are also those of three-dimensional control. But here, once we leave the air, a working medium is almost non-existent and cannot be relied on for reaction with control surfaces. Rather, a falling-body state is attained where the vehicle is coasting in a state of dynamic equilibrium with little or no resistance. It is falling toward the earth, but its speed is so

great it always falls over the edge, and thus continues round and round. No engine has to run. No fuel is consumed.

In a stable orbit, a satellite is the prisoner of forces external to it--the gravity of the earth and the centrifugal force generated by its speed. Any change in its attitude or trajectory requires the use of reaction motors, or jets. Control is not related to lift, thrust, and drag, as in the air, but rather with the ratio of thrust to inertia --elements contained in the vehicle itself.

The vehicle is in motion in a state of dynamic equilibrium, with the external forces balanced, and proceeds on its course until energy is used to change that course.

Is there an analogy here to the new kinds of systems we need to solve problems we now face in urban life, or to achieve economies of scale in programs for undeveloped regions? To succeed in these fields, I believe large scale endeavors are required and must start with a sufficient committed input of power to achieve the equivalent of "flying speed." They will need the ability to retain control through turbulent areas. They must have sufficient maneuverability to hold a course toward chosen objectives. And it may well be that a second generation of such endeavors will need to operate in a state equivalent to that of "dynamic equilibrium." It is quite likely that this will require substantial efforts to modify the environment itself.

There has been little effort to examine in depth the administrative features of our nation's experiences with the many kinds of large scale endeavors we have used. Some view these as so special--as so exceptional

--that little value, other than the historical, attaches to their study. They argue that adjusting government administration to rapidly changing conditions is necessarily a trial-and-error affair that defies systematization.

I would argue the reverse. As we have been able to study and master and apply over and over again the three-dimensional control innovation used by the Wright brothers, I believe we should be able to do something similar with the innovations that have made success possible in an accumulating number of quite diverse large scale endeavors. I believe these offer an important field of study. Such study offers the possibility of an important extension of management doctrine. It may provide a basis for extensions of theory.

The activities of NASA are free of many of the classification restrictions of the Department of Defense and the "trade secret" or proprietary restrictions of large industries. We are now in the process of opening NASA records and operations to responsible scholars for research sponsored by their universities. Through such research we believe we have an opportunity to help develop an increased national capability to carry out large and complex undertakings without each one having to start all over again.

Our society has reached a point where its progress and even survival increasingly depend upon our ability to organize the complex and to do the unusual. We cannot do the things we have to do except by the employment of large aggregations of power in highly specialized forms. We must do this under proper safeguards. We must avoid use of

this power haphazardly or arbitrarily or without important elements of social control. I believe we have a critical need for a proven way by which such aggregations of power can be applied in the context of our free institutions.

Many great social problems press in on us. We need the effective application of new knowledge through a diversity of skills drawn from many disciplines. We cannot solve the inner city problem without new approaches and new organizing methods. The same goes for air pollution; water pollution; highway congestion; and the increasingly dangerous imbalance in the world population-food ratio. Piecemeal attacks on these problems will simply not work. Neither will limited concepts of systems engineering or systems management.

The advance of technology is proceeding at a pace that defies the capability of the older concepts and methods to organize its effective use, or to keep under control its full effects. The technological revolution that is now so fully upon us is the most decisive event of our times. No nation that aspires to greatness, or to use its power for good, can continue as it has in the past. Unless it purposefully and systematically organizes for technological advance and works the fruits of that advance into the sinews of its society, it will surely fail its citizens.

The Soviet Union is also faced with these same forces generated by its own technical revolution. The difference is that it is bent upon shifting the balance of technological and general economic power in its favor. And it is working toward technological pre-eminence throughout the world.

The great issue of this age is whether the United States can, within the framework of acceptable institutions, organize the use and development of advanced technology as effectively as the USSR with its totalitarian system of allocating and utilizing human and material resources. The Soviet leaders assert, and really believe, that they have an immense advantage over us. I believe differently. I believe the capabilities of our system give us an immense advantage over all other systems. But we must organize ourselves effectively to develop and not to dissipate its strengths. To realize on such an opportunity is a responsibility that a great people owes to itself and to all mankind.

The use of great aggregations of resources in large scale endeavors to cope with complex and difficult situations is, of course, not unique to our times. There are many instances in history of undertakings requiring tremendous organizational efforts and use of resources. The ancient Chinese built their Great Wall; the Pharaohs, their Pyramids; the Romans, the Appian Way.

In the development of our own nation in the 19th and 20th centuries, the need for a system of canals required new engineering concepts and unique construction practices. The building of the transcontinental railway system is also a case in point. As local railways expanded from a few short lines along the Eastern seaboard into a trans-Allegheny and then a transcontinental net, a virtual organizational and management revolution was required. The American Academy of Arts and Sciences recently published a series of studies

which compared the development of our national railway system with our national space program. The striking aspect of this comparison is the extensiveness to which organizational and managerial innovations had to be employed in each case. Efforts to meet "problems inherent in the operation of a large railway, rather than theory or previous experience," determined the nature and content of the new system in which the decisive factor affecting the long-run development of the organizational structure "was the outside environment, rather than operational and technological considerations."

After 1865, "forces within the American economy threw the railroads into cut-throat competition, which in turn emphasized the non-operational problems of rate-making, finance, and the expansion through construction and purchase. Thus the operational managers were thrust aside and control gravitated to financiers who were chiefly responsible for administrative structures that evolved between 1865 and 1900."

In the development of our space systems we are now at that same point. "Non-operational" problems are already our limiting factor. What "administrative structures" can we devise to meet these? The answer is not yet in sight.

From its earliest days, the National Aeronautics and Space Administration has relied on the National Academy of Sciences to assist in the formulation of scientific goals, in the continuing examination of projects to accomplish these goals, and in assessing progress. More recently, the formation of the National Academy of Engineering has afforded an opportunity to work with leaders in that profession to

develop a different kind of relationship, but one equally important. This takes the form of the Aeronautics and Space Engineering Board which advises NASA on policies and programs related to effective engineering developments and the strengthening of related institutions, such as our engineering schools. Basic research is emphasized in both cases, and we are trying to more clearly understand how a governmental agency and an organized profession can best work together.

Just a few months ago the formation of the National Academy of Public Administration brought a third element to our growing national capability for joining science, engineering, and management. The National Academy of Public Administration is now developing ways and means through which research by competent scholars in the disciplines related to administration can utilize the various installations of NASA as laboratories. Its officials hope to utilize many of the research patterns of the anthropologist to understand how NASA administration actually takes place.

While we know much about the building of the Rockefeller petroleum empire, with its mobilization of widely diverse resources, we know all too little about how it met many complex and relatively unique organizational needs. We can say the same about the establishment of the U.S. Steel complex; the development of Sears Roebuck; General Motors; the DuPont chemical complex; and on through many others.

Our knowledge is inadequate in cases where the Federal government has found it necessary to supplement its regular administrative system with special endeavors aimed at meeting unusual needs. The land-grant

operation developed to aid agriculture and its higher education needs is one such example. The building of the Panama Canal is another. And in the era of the Great Depression, large scale efforts were introduced on a variety of fronts, of which perhaps the Tennessee Valley Authority is best known.

During the Second World War large scale endeavors played a critically important role. We found that within the framework of the over-all war effort we had to organize quite large and complex special activities to get difficult and urgent jobs done that could not be accomplished by existing organizations and established methods and procedures.

The Manhattan Engineering District was the most celebrated. President Truman, in his Memoirs, described this as a "vast undertaking" which "had no parallel in history." It brought together in secret establishments around the country large numbers of scientists and engineers drawn from universities, industry, and the government itself, and a tremendous number of support personnel. These were isolated from outside interests and contacts, and assigned the job of developing and testing new scientific concepts, engineering new machines and processes, and marshalling the diverse resources necessary to make a weapon that had never been made before. Sections of great industrial enterprise were, in effect, made component parts of the project. Giant laboratories were built and operated under contract by companies like General Electric and Union Carbide. In other words, we created an integrated "team of teams" and used it with an overriding singleness

of purpose to accomplish on a crash basis something never before accomplished. The job was done within a strikingly short period of time.

The Office of Price Administration was the largest, most widely known, and most pervasive of the special wartime endeavors. A National Academy of Public Administration summary describes the unprecedented nature of the task undertaken by the OPA as "to wage war and make peace without at the same time suffering the ills of large-scale inflation and deflation . . . ." There were many who thought that the task of substituting conscious governmental controls for the relatively mechanical functioning of the market place was beyond the power of human endeavor; but on balance the war record is astonishingly good. Price stabilization was achieved in the face of inflationary potentialities unequalled in the country's modern experience. More than this, it was achieved while new production records were being made in almost every field of manufacturing and production.

Petroleum was a different problem. Submarine warfare had played havoc with the flow of oil to our major industrial centers while our requirements were sharply rising. We had to produce more oil and move it quickly to points of critical need. Massive new activities and resources were necessary. Efforts to meet the situation through improvisations utilizing existing organizations and regular methods failed. A single authority, the Petroleum Administration for War, was established and met the need.

A similar operation was necessary for rubber; for building the massive fleet of commercial ships; for meeting critical housing and construction requirements; for increasing the manpower resources necessary for new and greatly expanded industries; and so on down a surprisingly long list.

As the war drew to an end, a strong movement developed to force the Federal government to abandon these large scale endeavors and to liquidate the various extraordinary activities in which it had become engaged. The thought was that the old-line agencies and departments, and the old methods, would be adequate to meet peacetime problems. It was soon apparent, however, that the peacetime problems of the late 1940's required many of the same specialized organizational efforts and approaches as wartime problems. For the first time in our history we had to establish a centralized intelligence agency. We came to recognize the need for a "Voice of America," and the Atomic Energy Commission was set up.

As to the old-line departments and pre-war agencies during the war, they were enormously expanded, both in personnel and in responsibilities. The Departments of Commerce, State, Interior, Agriculture, Treasury, the Veterans Administration, the Justice Department, specialized agencies dealing with housing and transportation, and even the regulatory agencies, took on complex new functions.

The separation of the Air Force from the Army, and then the combination of the three military services within a single Department of Defense, was a monumental undertaking. Establishment of the National Security Council marked a step forward.

In 1948, with a Republican Congress and a Democratic Administration, the first Hoover Commission on Government Reorganization was established. Former President Hoover was made Chairman and Mr. Dean Acheson Vice Chairman. As Director of the Bureau of the Budget, it was my responsibility to serve as liaison between President Truman and President Hoover. We in the Truman Administration were able, on the basis of a mutual willingness of all participants to be realistic, to work well with Mr. Hoover and the Commission. A large number of the ideas and concepts that had been developed from experience were incorporated in the Commission's recommendations.

The Hoover Commission devoted much attention to the Department of State. It emphasized the incongruity between the organizational structure and the methods and procedures of the department, on the one hand, and the requirements raised by the rapidly changing environment in which our foreign policy was being conducted.

The Department of State had become after the war a giant conglomerate. New functions and personnel were piled on its very small base. Moreover, as U.S. world responsibilities grew, new units and new groups of personnel were added to do special jobs. The organizational structure of State and its methods of doing business were completely inadequate to absorb, much less utilize, the resources that were heaped upon it--and this at a time when we needed all the means we could command to increase our effectiveness in foreign affairs.

The organizational heart of the department--that is, the "inner" department of operating bureaus--remained much as it had developed

during the 1920's and 1930's. Resting on a base of "country desk officers," it reported to the Secretary through a pyramidal command structure. This inner department prided itself on its self-containment, with little knowledge or understanding of what was going on elsewhere in the department or in other agencies. It was this inner department which commanded most of the time of the Secretary and on which he largely depended for the information and judgments needed in the decision-making process, and for the development of strategy and tactics. There were few systematized means whereby many areas of the Department could be drawn into the day-to-day councils and deliberations of the Secretary.

The Hoover Commission recommended sweeping changes to bring the Department up to date. The Vice Chairman of the Commission, Mr. Acheson, was appointed Secretary of State. I soon joined him as Under Secretary and we set as a major goal the reorganization of the Department along the lines recommended by the Hoover Commission.

The pyramidal system was "flattened out." The organizational structure just below the Secretary/Under Secretary level was greatly broadened in order to delegate responsibilities downward. Assistant Secretaries were appointed for each of the main geographical areas of the world--that is, for Europe and the British Commonwealth, for the Near and Middle East and Africa, for Latin America, for the Far East, and for South and Southeast Asia. Two new senior officials, a new Deputy Under Secretary for Political Affairs, and another for Administrative Affairs, were appointed. The Heads of functional

divisions such as Intelligence Research, Legal Affairs, Policy Planning, and others who were previously outside the mainstream of departmental operations, were brought into the senior group with status equivalent to that of the Assistant Secretaries. Each Assistant Secretary was charged with overall direction of operations within his area; insuring coordination between his bureau and other bureaus, and effectively utilizing all available resources in and outside the Department in carrying out his responsibilities. Each Assistant Secretary was charged with administrative as well as substantive leadership.

A communications network was so structured as to insure open lines of communications hierarchically and laterally and to provide a continuing feedback of information on performance against policies, decisions, and instructions. Much of this was accomplished through the Executive Secretariat.

Mechanisms were established whereby all intelligence information available either in the Department or in other agencies could be introduced on a real time basis into deliberations of The President and the Secretary as well as in the day-to-day work at lower levels. The research resources available in the Department were reordered so as to bring them directly to bear on problems and missions of immediate and continuing importance. Among other things, a system was established whereby needs could be anticipated and research and other preparatory work done in advance so as to be readily available on need. We established an inter-agency "Watch Committee" to serve as a

centralized point for pooling all intelligence information that might give early indications of developments adverse to our interests. We also joined in the development of systematized national intelligence estimates on both a regular and special need basis.

I point to these experiences in the organization and reorganization of our government during the early post-war years because the effort represented a successful endeavor not just to improve governmental operations, but to achieve a better and more effective governmental system. There was then no wartime emergency. The aim was more than to work our way through trying times and difficult situations. It was to equip ourselves with the tools and to find an organizational pattern through which we could cope, on a world-wide basis, with the complex, the unusual, and the uncertain. We were seeking to adjust to a new and demanding national and international environment, and to do this in a way that would prepare us to cope with further changes. We wanted a system of administration that would bring to the fore the essential ingredients required for good judgment at critical points of decision and effective action in the handling of complex and difficult matters. Our aim was to work toward the use of what we now call "feedback" in a "closed loop" system. Our aim, if you will, was good government.

This brings me to a concern I feel needs emphasis.

We often talk about what is bad in government. My observations and experiences lead me to feel that there is much that is good in government. For a long time many responsible officials have sought with much earnestness and persistence to adapt the administrative

processes with which we have lived so long, and which are so central to our institutional structure, to the requirements of a new age, and to do this without damage to the essential features and basic values of our society.

Few seem now to recall how well our government met the first post-war challenge--the Greece and Turkey aid program. This proved a most complex enterprise, requiring a combined military, economic, diplomatic, morale-building, training and educational program. It involved both a variety of government agencies and private enterprises and establishments. Moreover, it depended for success on getting action and decisions from the divided, confused, and dispirited Greek and Turkish leaders. And we had constantly to take into account the wishes and activities of our allies, as well as the maneuvers of a relentless adversary. Later we were to have many rounds with similar situations, but in 1947 we were little experienced and were ill equipped to measure up to the commitments we felt we had to assume. We had virtually no time in which to prepare ourselves. We had to do everything under the pressure of imminent disaster. We had the resources, and this was not the problem. The problem was organizing the use of the resources. And for this a whole set of new rules and procedures in management had to be developed and put into operation.

Hardly had the Greek-Turkish aid program gotten under way when a crisis in Western Europe caused the United States to embark on an even larger endeavor, the Marshall Plan. In the words of President Truman: "Never before in history has one nation faced so vast an undertaking

as that confronting the United States of repairing and salvaging the victors as well as the vanquished." What was needed and what the Marshall Plan provided was a comprehensive program for a large population in many nations to salvage their economic program based upon U.S. material assistance. The Europeans needed technological and managerial guidance coupled with a means for disciplined self-help. They were, of course, highly developed and educated people living in nations with long traditions. They had the base and the capability necessary for reestablishing viable conditions. But they lacked many of the components required for getting industrial and other establishments going again, or achieving political and social stability. Most of all, they lacked the spirit and the will to dig themselves out of the economic, political, and psychological debris left by the ravages of war. Also, ominous threats were always in the background.

When the Marshall Plan was launched in the summer of 1947, it called for an outlay of $20 billion over a four-year period. This was revised down to $16 billion in the budget requests to Congress. There were committees and task forces in a variety of agencies, and inter-agency groups operating within the Executive Office of the President. We organized to do this job as we had seldom organized in peacetime before, and it turned out to be a magnificent success. With it we proved much about what could be done through skillful and purposeful organizing on a large scale.

In the 1950's, when Soviet rocket power threatened to make our air power obsolete, we undertook a vast program to give us an

intercontinental missile capability. This was a $50 billion endeavor spread over most of a decade. Like the Manhattan District, it centered primarily on the use and development of advanced technology. Its complexities were so great that it required a whole range of new administrative concepts. It involved the systems approach to management on a grand scale. And alongside this special enterprise, we worked toward a general overhaul of our entire weapons complex, including entirely new aeronautical systems. We also successfully carried out the Polaris nuclear submarine missile launcher program, a large scale endeavor within the larger U.S. Navy.

The accomplishments of the ballistic missile and related endeavors formed a solid foundation of know-how which we used when we embarked on the latest--and the most complex--of the large scale endeavors we have undertaken: our national space program.

All of us well remember the impact of Sputnik and the consequential traumatic circumstances that led us to move out in space. There was the shocked realization that Russia had become a first class technological power, capable of successfully challenging us in an area where we had felt secure; the deep concern that the balance of strategic power may have been tilted against us; the awed world-wide response to the Soviet success; the new stridency of claims regarding the superiority of the Soviet-Communist system; and even deeply troubled questioning within our own ranks as to whether our ways and our values could measure up to the demands of a new age. Many felt trapped by forces beyond their control; desperate to prove to themselves and others that what they feared was not true.

Actually, we were better off than most of us thought. We had a number of valuable things going for us. We had nearly all of the resources, nearly all of the means needed to do the space job. And what we did not have, we could bring into being. The big problem--the big task--was to organize the use of what we had and to do this in such a way as to bid for continued support over the long time required to demonstrate results. The matter came down to management, the organization and administration of the most complex of the large scale endeavors our nation has undertaken, and to do this in close association with four Congressional committees which included 124 members whose confidence we must get and retain.

In these lectures I will say more about how we proceeded with this task of organizing, managing, and reporting on the space program. I will try to show why we did some things and not others. I will point out some failures as well as some successes.

It will be my purpose to develop these matters not entirely in the context of the NASA operation itself. I will try to set them within the context of our nation's general experiences with large scale endeavors, and to show their usefulness for future tasks.

In speaking of large scale endeavors you will note that I have avoided attempts at definition. Such endeavors quite clearly do not conform to uniform patterns.

They may be public or private, or essentially a mixture of the two. They may be socially motivated or profit motivated. They may have to do with either a civilian or a military situation.

They may be designed to meet a critical problem, or to capitalize on a unique opportunity. They may involve a complex of tasks or aim at getting a single major job done.

They may be more or less self-contained, or extend over a variety of organizations and institutions. They may be of relatively short duration, or continuing. They may involve hundreds of thousands of production workers and highly specialized teams of scientists and engineers. They may be principally concerned with the utilization and development of advanced technology or with new applications of old technology. They may be vested with great authority and power to marshall the human and material resources needed, or they may be dependent upon self-generated energies and skills.

But however great the diversity among such large scale endeavors, there are important common threads that run through them. Seven of these come to mind:

First: They are ordinarily undertaken as a result of a significant change in the environment--social, political, technological, military, or others--which raise a new and urgent need, or present a significant new opportunity.

Second: Interaction between the environmental situation and the endeavor is a continuous process. As changes in the environment produce the endeavor, so do subsequent changes work for continuing modifications in the nature of the job being done and in the tools needed and available to do it. Pressures may arise from what happens in the endeavor itself. Or they may have other sources as, for example, the rise of new competing demands on scarce resources; growing effectiveness of a

dissenting minority; a change in popular attitudes; a change in the political balance.

A third very important common feature of large scale endeavors is that organizing, administering, reorganizing, and the administration of the reorganized structure, is the key to their effectiveness and usefulness rather than inventing an entirely new machine or process. For most large scale endeavors the knowledge and technology and the human and material resources necessary for the job were already in being. The requirement has been to effectively organize the use of what was at hand. This has been true even for endeavors like NASA and the Manhattan District which might appear singularly dependent upon invention or "new" knowledge and technology.

Fourth: Large scale endeavors also do not generally require new organizational and administrative forms but the more effective utilization of existing forms. Some endeavors have not even required new organizational structures, or at least not all-encompassing structures. NASA, for example, has made use of a wide variety of pre-existing structures. The Corps of Engineers has used much the same organizational structure while carrying out, over time, a variety of large scale endeavors. The Marshall Plan was largely managed on the U.S. side through utilizing the resources of existing governmental agencies and commercial practices.

Fifth: All large scale endeavors do have a number of special requirements. They depend on men with special, often unique, skills; men of high intelligence and creativity; men trained in a variety of

of disciplines; men who by their very nature raise special problems for management. Communications are of unusual importance; and particularly communications related to the collection and use of feedback. Enormous quantities of data are indispensable, but this in its turn creates a special problem of unwanted data or "noise" and possibilities of confusion. The need is for a sure means to select what is needed when it is needed and put it where it is needed. A large scale endeavor is so complex that the chief executive and his senior associates cannot have detailed knowledge and expertise for every facet. They must delegate important responsibilities to lower echelons and then find ways to make sure the delegations accomplish their purpose without harmful compartmentation.

Sixth: Another common denominator of large scale endeavors is the necessity of a continuing "critical mass" of support. There must be enough support and continuity of support to retain and keep directly engaged on the critical problems the highly talented people required to do the job, as well as to keep viable the entire organizational structure. As with an airplane, the initial support must be adequate to attain the equivalent of "flying speed" and continued support must be adequate to maintain the equivalent of an efficient flight path. Any uncertainty or shortfall in the support factor is apt to have large effects on the result and force the endeavor into serious difficulties.

Seventh: A number of intangibles also mark large scale endeavors. All have important secondary and tertiary effects other than those associated with the prime objective. These alter the environment and

significantly impact events generally. All tend to have a high degree of uncertainty regarding precise end results. The costs of inadequacy or failure are invariably high. Finally, the large scale endeavor has a very high potential for participants, which helps to attract the creative individual.

Can we now ask how a nation like the U.S. should approach future projects of the complexity just described: Should we proceed as with any other job, applying the same methods and procedures, only on a larger scale? Should we despair of any help from existing doctrine and practice and try to build an entirely new element? Or should we try for a successful mix of the old and the new through careful planning and new experimental approaches?

One thing is obvious. The first essential for success is to operate as efficiently and productively as possible. Whoever is responsible must employ workable management tools. These tools may be old or new. That is not important. The important thing is that they work, that they be used, and that available tools not be overlooked.

Men have been searching for good management tools throughout the ages. Texts on management have a way of going back to the ancient Sumarians, or Chinese, or Hebrews for a point of departure. Historically, each society has made its contributions. Machiavelli had a good grasp of the basic rules and principles in the early sixteenth century. So did Pope Gregory the Great in the late sixth. And for some types of management problems, it would be difficult to improve on the Benedictine Rule, also of the sixth century.

The systematization of these traditional rules and principles by the so-called "Scientific School" of management at the turn of the century resulted in a body of doctrine which, for all of its publicized faults, provides building blocks from which parts of a large scale endeavor can be constructed. An hierarchical system of authority, the hallmark of the traditionalists, is in one form or another essential. Basic principles covering "delegation of authority" and "division of labor" must be applied. The span of control must have some limit, and tasks must be structured so that there is a logical and consistent relationship between functions.

Yet as a system of management, the traditional doctrine constructed by Taylor, Weber, Fayol, and others, is not suited to the very large, complex undertaking. A slavish application of the "Fourteen Principles" which Fayol used in 1916 (which sums up the essence of the traditional doctrine and which still provide the backbone of much of the management training of today) would almost certainly guarantee the failure of any complex large endeavor. The fundamental shortcoming is the assumption of a highly rigid and inflexible structure. Fayol and Taylor were engineers who applied engineering design concepts to organization; they assumed it would then operate in much the same way as an internal combustion engine. The participants in the organization were viewed as multi-purpose, poorly designed machines. These concepts apply quite well to routine, repetitive, and stable operations. But they are self-defeating for the highly complex endeavor making its way in a turbulent environment, where rapid change and adjustment are of the essence.

Just as we can use some but not all of the doctrinal principles of the traditional school, we can also use parts of the newer doctrine of the behavioral or participative school. Developed through a synthesis of social science theories about man and "tested" in a limited number of highly controlled experiments, this doctrine argues that the traditional organization is in conflict with the needs of the mature individual and that the organizational atmosphere must permit all individuals to interact freely through all levels of the structure. It further argues that the goals of an organization can be efficiently achieved only if there is a fusion between them and the goals of the individual.

There is certainly validity and usefulness in such concepts. They include interdependency of human relationships, self-motivation, self-actualization, and recognition of the informal group structure within a formal organization.

On the other hand, the complexity and enormous scale, and the actual and potential side effects, of the large scale endeavor cannot allow the degree of participation in goal setting and operation envisaged by the behavioralists.

Others have, of course, noted the inadequacies of the doctrines of both the traditionalists and the behavioralists. An entirely new school, one that advocates an "evolutionary" or "systems" doctrine appears to be emerging. A main concern of this school is the concern I have expressed--the increasing size and complexity of corporations and government operations. Its thinking has opened broad new vistas

and introduced a variety of tools that are particularly useful. It has given us a new approach based on both a "general systems theory" and a "situational" concept. It has helped to transform practice from a compartmented mode of operation to a highly integrated one, which is, of course, of great importance. It has also pointed up the necessity for managers to base their actions not on a rigid set of principles, as was the case with the traditionalists and to some extent with the behavioralists, but instead to recognize that these actions must be adapted to particular situations, organizational levels, and the human beings involved. Above all else perhaps, the "systems" school has emphasized the importance of quantitative methods of analysis in the use of the ever-increasing quantities of data generated by the computer. Operations Research is prominent among the new techniques.

Even a casual reading of the literature of the "systems" school will reveal, however, that it too is inadequate to the aggregate of the requirements of the large scale endeavor. It is given to generalizations based upon special and often artificial situations. Sophisticated mathematics and conceptual model building, without the essential foundations of observation and first-hand study, sometimes seem to be the sources of its development.

As a general matter, all this indicates our need to recognize a significant lag in management doctrine. There is an urgent need to research our experiences with complex activities and to systematize our findings so that better doctrine can be developed into the workable guide it ought to be.

The essence of the problem, it seems to me, is more emphasis on research. In actual practice where do doctrinal principles work and where do they fail? What additions or changes are necessary to update and strengthen doctrine? These are the things we need to find out more about, and this means thorough and systematic examinations of concrete experiences. Professor Leonard Sayles, of Columbia University Graduate School of Business, has entitled a forthcoming article "Whatever Happened to Management?" He points out that management as a field of study has been seriously lacking in down-to-earth research; that in the past those who achieved greatness in the social and behavioral sciences did so because they "immersed themselves in the affairs of man and built their powerful abstractions on the basis of prolonged first-hand experience." Pointing out that this methodology has become less fashionable, Dr. Sayles adds, "given the absence of an accepted research tradition, the field of management and all its branches (human relations, organization theory, organization behavior) often rests on proselytizing."

There are any number of instances in the conduct of large scale public and private endeavors where established doctrine--even the latest "systems" doctrine--has proved deficient. There had to be exceptions, and innovations with few guides from doctrine.

It is to these instances that research should be directed. Important findings may be uncovered there.

In the next of these McKinsey lectures I plan to touch upon two broad areas where exceptions have been particularly necessary in the

large scale endeavor. The first I have called Goal Setting and Feedback; and the second, Executive Performance and its Evaluation.

Perhaps, then, I can conclude this lecture with a thought from the period before World War I, when technology and industrialization were forcing new social adaptations.

In about 1910 Woodrow Wilson began to change his views on how America would meet the future. He stated that this nation was no longer content, as he had previously believed, with the progress that could come through an orderly development of our legal system. He wrote: "The transition we are witnessing is no equitable transition of growth and normal alteration, no silent, unconscious unfolding of one age into another, its natural heir and successor. Society is looking itself over in our day from top to bottom, is making a fresh and critical analysis of its every element, is questioning its oldest practices as freely as its newest, scrutinizing every arrangement and motive of its life and stands ready to attempt nothing less than a radical reconstruction."

Wilson came to believe that our nation's vitality, its strength and its needs, made obsolete patterns based on a slowly evolving "common law" concept.

Out of this new line of thought came the quick but sweeping reforms of Wilson's first years as President and much that followed later.

I believe we are in a similar age. There is great need for new concepts to take hold. Just as "common law" concepts had to give way

to "statutory law" in Wilson's time, it is advocated today that needed reforms cannot wait for normal legislative periods of gestation but must be forced. On the other hand, we do now have the tools to free our society of many of its burdens and to carry it to new levels of achievement. What we lack is a dependable operating concept acceptable to our elected representatives of how we can deliberately and purposefully use those tools to shape our own destiny, to choose attainable goals, and to insure continuing progress toward those goals.

An April 1968 issue of Science gives an interesting account of recent experiments to test the efficiency of Stone Age tools. These tests revealed that the tools made of stone were generally as effective for their purposes as the later tools made of metal. The conclusion was that: "Stone Age man may have been better equipped than we suppose; his tools and weapons were cheap, sharp, and very enduring." *

Why then did the Stone Age last so long? Why did it change so little over its long life?

Many believe it was the failure, or inability, of Stone Age man to develop concepts that would demand and make possible the fuller use of his tools for broader and greater purposes than the accepted and the traditional. In the Science issue of July 31, 1964, V. Edwin Bixenstine expressed this idea: "The great advances of science are

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* A. C. Custance, "Stone Tools and Woodworking," in Science, April 5, 1968, p. 101.

associated with its grand conceptions even more than with its discoveries." ** Perhaps we should broaden Bixenstine's thought to the great advances of man himself. This is what we ought to have in the back of our minds as we consider the past and the future of societies' use of large scale endeavors.

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** V. Edwin Bixenstine, "Empiricism in Latter-day Behavioral Science," in Science, July 31, 1964, p. 464.